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 TITLE: FORMATION OF CONTACT WINDOW

PUBN-DATE: September 13, 1996

INVENTOR-INFORMATION:

NAME	COUNTRY
KENO, TAKUJI	
OGIWARA, ATSUSHI	
EDA, KAZUO	

INT-CL (IPC): H01 L 21/28; H01 L 21/306

ABSTRACT:

PURPOSE: To stably form a contact window which has an excellent electrode coverage.

CONSTITUTION: After a single-crystal silicon oxide film 11 is formed on the surface of a semiconductor substrate 10, a polycrystalline silicon film 12 containing no dopant and single-crystal silicon nitride film 13 are successively formed on the film 11. The nitride film 13 is then removed from the forming area of a contact window 16 and the film 12 in the forming area is thermally oxidized. After oxidizing the film 12, oxide films 15 and 11 are removed from the forming area by using a fluorine-based etchant and the nitride film is removed from the same area. Therefore, the edge section of the window 16 becomes smooth.

L8 ANSWER 65 OF 104 CAPLUS COPYRIGHT 2005 ACS on STN

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TI Formation of ***contact*** holes for bump ***contacts*** in MOS semiconductor devices

IN Keno, Takuji; Ogiwara, Atsushi; Eda, Kazuo

PA Matsushita Electric Works Ltd, Japan

SO Jpn. Kokai Tokkyo Koho, 7 pp.

CODEN: JKXXAF

DT Patent

LA Japanese

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PI	JP 08236475	A2	19960913	JP 1995-34853	19950223
PRAI	JP 1995-34853		19950223		

AB The title formation of micro- ***contact*** holes (size 1 .mu.m rule-level) involves forming an oxide film on a single crystal Si semiconductor substrate, depositing a non-doped polycryst. Si film on the oxide film, forming a single cryst. Si nitride film on the Si film, selectively ***removing*** the Si nitride film for opening in formation of a ***contact*** hole, thermally ***oxidizing*** the non-doped ***polycryst*** . ***Si*** which is exposed through the nitride film, ***etching*** to ***remove*** the thermally oxidized film with F-contg. ***etchant***, and subsequently ***removing*** the remaining nitride film. The process gives the opening a rounded corner of the opening edges so as to provide an refractory metal bump ***contact*** electrode in the hole with an improved and secured adhesion in the hole.

L1: Entry 1 of 1

File: DWPI

Sep 13, 1996

DERWENT-ACC-NO: 1996-469938

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102b-1-2,5-6

TITLE: Contact window formation method, e.g. in MOS semiconductor device - involves carrying out etching using fluorine system for removal of predetermined portion of nitride and polycrystalline films to form contact window

PRIORITY-DATA: 1995JP-0034853 (February 23, 1995)

Search Selected

Search ALL

Clear

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
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ABSTRACTED-PUB-NO: JP 08236475A

BASIC-ABSTRACT:

The method involves forming initially a single crystal silicon oxide film (11) over the surface of a semiconductor substrate (10).

A polycrystalline film (12) and a nitride film (13) are formed sequentially over the surface of the oxide film. Then, the predetermined portion of the nitride and polycrystalline film is removed by etching using fluorine system. Thus, a contact window (16) is formed as covering nature of an electrode by heat oxidation process.

ADVANTAGE - Reduces number of process. Enables durability and reliability of electrode wiring to be improved.

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(71) 出願人 000005832

松下電工株式会社

大阪府門真市大字門真1048番地

(72) 発明者 毛野 拓治

大阪府門真市大字門真1048番地松下電工株式会社内

(72) 発明者 荻原 淳

大阪府門真市大字門真1048番地松下電工株式会社内

(72) 発明者 江田 和夫

大阪府門真市大字門真1048番地松下電工株式会社内

(74) 代理人 弁理士 佐藤 成示 (外1名)

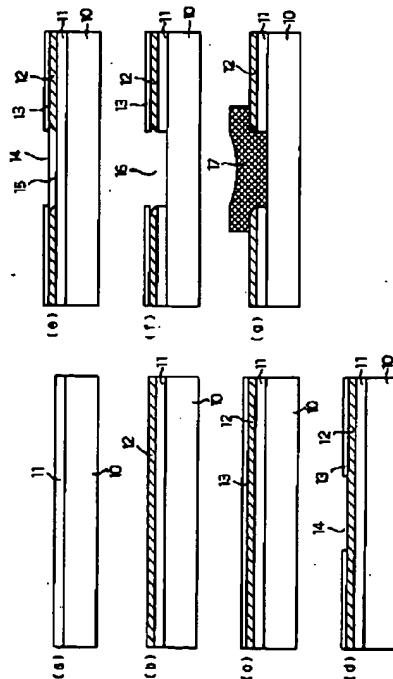
(54) 【発明の名称】 コンタクト窓の形成方法

(57) 【要約】

【目的】 安定的に、電極の被覆性の良いコンタクト窓を形成する。

【構成】 半導体基板10の表面に単結晶シリコンの酸化膜11を形成し、その上に、ドーパントを含まない、単結晶シリコンの多結晶膜12を形成し、その多結晶膜12上に、単結晶シリコンの窒化膜13を形成し、コンタクト窓16を形成する箇所の窒化膜13を除去し、熱酸化によりコンタクト窓16を形成する箇所の多結晶膜12を酸化し、コンタクト窓16を形成する箇所の酸化膜15、11をフッ素系のエッチャントで除去し、窒化膜13除去する。

【効果】 コンタクト窓のエッジ部分が滑らかな形状になる。



【特許請求の範囲】

【請求項1】 半導体装置の表面に電極を接触させるためのコンタクト窓を形成する方法であって、前記半導体装置の表面に単結晶シリコンの酸化膜を形成する工程と、その酸化膜上に電気伝導に寄与するドーパントを含まない、単結晶シリコンの多結晶膜を形成する工程と、その多結晶膜上に高融点材料で構成された高融点膜を形成する工程と、コンタクト窓を形成する箇所の前記高融点膜を選択的にエッチング除去する工程と、熱酸化により前記コンタクト窓を形成する箇所の前記多結晶膜を酸化する工程と、前記コンタクト窓を形成する箇所の前記酸化膜をフッ素系のエッチャントで除去する工程と、前記高融点膜をエッチング除去する工程とを備えたことを特徴とするコンタクト窓の形成方法。

【請求項2】 半導体装置の表面に電極を接触させるためのコンタクト窓を形成する方法であって、前記半導体装置の表面に単結晶シリコンの酸化膜を形成する工程と、その酸化膜上に単結晶シリコンの多結晶膜を形成する工程と、前記コンタクト窓を形成する箇所の周囲の前記多結晶膜を選択的にエッチング除去する工程と、熱酸化により前記多結晶膜を酸化する工程と、CVDにより表面にCVD酸化膜を形成する工程と、前記コンタクト窓を形成する箇所の、熱酸化により形成された酸化膜及びCVD酸化膜を、選択的にエッチング除去する工程と、前記コンタクト窓を形成する箇所に露出した前記多結晶膜をエッチング除去する工程と、前記コンタクト窓を形成する箇所の前記酸化膜、及び、その周辺の、前記酸化膜及び前記CVD酸化膜をフッ素系のエッチャントで除去する工程とを備えたことを特徴とするコンタクト窓の形成方法。

【請求項3】 表面にMOS構造のゲートを形成する半導体装置で、表面の所定領域と電極を接触させるためのコンタクト窓を形成する方法であって、前記半導体装置の表面に単結晶シリコンの酸化膜を形成する工程と、その酸化膜上に電気伝導に寄与するドーパントを含む、単結晶シリコンの多結晶膜を形成する工程と、前記ゲートを形成する箇所及び前記コンタクト窓を形成する箇所以外の前記多結晶膜を選択的にエッチング除去する工程と、CVDにより表面にCVD酸化膜を形成する工程と、前記コンタクト窓を形成する箇所の、前記酸化膜及びCVD酸化膜を、エッチング除去する工程と、前記コンタクト窓を形成する箇所に露出した前記多結晶膜をエッチング除去する工程と、前記コンタクト窓を形成する箇所の前記酸化膜、及び、その周辺の、前記酸化膜及び前記CVD酸化膜をフッ素系のエッチャントで除去する工程とを備えたことを特徴とするコンタクト窓の形成方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、1 μ mルールレベルの

MOS半導体装置等のコンタクト窓の形成方法に関するものである。

【0002】

【従来の技術】1 μ mルールレベルの半導体装置のコンタクト窓の形成には、微細プロセスに特化されず、様々な製法が考案されている。ここではそのうち2つの例について説明する。

【0003】図4の断面図に基づいて従来のコンタクト窓の形成方法の一例について説明する。一般に、コンタクト窓を形成する前は、(a)に示すように、半導体基板1の表面に絶縁用の酸化膜2が形成された状態となっており、このまま、微細パターンのコンタクト窓をあけると、段差部が階段状態となり、そのコンタクト窓に形成する電極の被覆性が悪くなるため、(b)に示すように、酸化膜2よりやや緻密性の悪いCVD酸化膜3を酸化膜2上に蒸着する。次に、(c)に示すように、コンタクト窓を形成したい箇所の、酸化膜2及びCVD酸化膜3を選択的にエッチング除去してコンタクト窓4を形成する。さらに、(d)に示すように、アニール（熱処理）により、コンタクト窓4周囲のCVD酸化膜3の上端部のエッジ5を丸め、コンタクト窓4に形成する電極の被覆性を改善する。

【0004】図5の断面図に基づいて従来のコンタクト窓の形成方法の異なる例について説明する。まず、

(a)に示すように、半導体基板6の表面に絶縁用の酸化膜7を形成した後、(b)に示すように、酸化膜7上に、P₂O₅を含んだCVD酸化膜（以下、PSG8と呼ぶ。）を蒸着する。次に、(c)に示すように、コンタクト窓を形成したい箇所の、酸化膜7及びPSG8を、選択的にエッチングすると、PSG8のエッチングスピードが酸化膜7より速いために、コンタクト窓9のエッジ10が滑らかな形状になるので電極の被覆性が改善される。

【0005】

【発明が解決しようとする課題】しかし、以上に説明した方法では、安定的に、図4及び図5に示した形状にコンタクト窓を形成することは困難であった。

【0006】本発明は上記課題に鑑みなされたもので、その目的とするところは、1 μ mルールレベルの半導体装置において、安定的に、電極の被覆性の良いコンタクト窓を形成することができるコンタクト窓の形成方法を提供することにある。

【0007】

【課題を解決するための手段】上記目的を達成するため、請求項1記載のコンタクト窓の形成方法は、半導体装置の表面に電極を接触させるためのコンタクト窓を形成する方法であって、前記半導体装置の表面に単結晶シリコンの酸化膜を形成する工程と、その酸化膜上に電気伝導に寄与するドーパントを含まない、単結晶シリコンの多結晶膜を形成する工程と、その多結晶膜上に高融点

材料で構成された高融点膜を形成する工程と、コンタクト窓を形成する箇所の前記高融点膜を選択的にエッチング除去する工程と、熱酸化により前記コンタクト窓を形成する箇所の前記多結晶膜を酸化する工程と、前記コンタクト窓を形成する箇所の前記酸化膜をフッ素系のエッチャントで除去する工程と、前記高融点膜をエッチング除去する工程とを備えたことを特徴とするものである。

【0008】請求項2記載のコンタクト窓の形成方法は、半導体装置の表面に電極を接触させるためのコンタクト窓を形成する方法であって、前記半導体装置の表面に単結晶シリコンの酸化膜を形成する工程と、その酸化膜上に単結晶シリコンの多結晶膜を形成する工程と、前記コンタクト窓を形成する箇所の周囲の前記多結晶膜を選択的にエッチング除去する工程と、熱酸化により前記多結晶膜を酸化する工程と、CVDにより表面にCVD酸化膜を形成する工程と、前記コンタクト窓を形成する箇所の、熱酸化により形成された酸化膜及びCVD酸化膜を、選択的にエッチング除去する工程と、前記コンタクト窓を形成する箇所に露出した前記多結晶膜をエッチング除去する工程と、前記コンタクト窓を形成する箇所の前記酸化膜、及び、その周辺の、前記酸化膜及び前記CVD酸化膜をフッ素系のエッチャントで除去する工程とを備えたことを特徴とするものである。

【0009】請求項3記載のコンタクト窓の形成方法は、表面にMOS構造のゲートを形成する半導体装置で、表面の所定領域と電極を接触させるためのコンタクト窓を形成する方法であって、前記半導体装置の表面に単結晶シリコンの酸化膜を形成する工程と、その酸化膜上に電気伝導に寄与するドーパントを含む、単結晶シリコンの多結晶膜を形成する工程と、前記ゲートを形成する箇所及び前記コンタクト窓を形成する箇所以外の前記多結晶膜を選択的にエッチング除去する工程と、CVDにより表面にCVD酸化膜を形成する工程と、前記コンタクト窓を形成する箇所の、前記酸化膜及びCVD酸化膜を、エッチング除去する工程と、前記コンタクト窓を形成する箇所に露出した前記多結晶膜をエッチング除去する工程と、前記コンタクト窓を形成する箇所の前記酸化膜、及び、その周辺の、前記酸化膜及び前記CVD酸化膜をフッ素系のエッチャントで除去する工程とを備えたことを特徴とするものである。

【0010】

【作用】請求項1記載のコンタクト窓の形成方法は、まず、半導体装置の表面に単結晶シリコンの酸化膜を形成し、その酸化膜上に電気伝導に寄与するドーパントを含まない、単結晶シリコンの多結晶膜を形成し、多結晶膜上に選択性エッチングの可能な高融点材料で構成された高融点膜を形成する。次に、コンタクト窓を形成すべき箇所の高融点膜を選択的にエッチング除去し、熱酸化により高融点膜に覆われていない多結晶膜（コンタクト窓を形成する箇所の多結晶膜）を完全に酸化して、多結晶

膜を局部的に酸化膜に変えておき、フッ化水素酸等のフッ素系のエッチャントで全面エッチングする。これにより、コンタクト窓を形成すべき箇所の酸化膜が選択的にエッチングされる。熱酸化の際、高融点膜に覆われていた多結晶膜のうち、コンタクト窓となる箇所の近傍の多結晶膜は、酸化されて酸化膜に変化するので、コンタクト窓の上端部は滑らかな形状となる。これにより、電極の被覆性が向上する。

【0011】請求項2記載のコンタクト窓の形成方法は、まず、半導体装置の表面に単結晶シリコンの酸化膜を形成し、その酸化膜上に単結晶シリコンの多結晶膜を形成し、コンタクト窓を形成する箇所に多結晶膜が残るように、その周囲の多結晶膜を選択性エッチングにより除去した後、熱酸化により多結晶膜を酸化し、表面に絶縁用の酸化膜（CVD酸化膜）を形成する。さらに、コンタクト窓を形成する箇所の、熱酸化により形成された酸化膜及びCVD酸化膜を、フォトリソグラフィ工程を用いて選択的にエッチング除去する。

【0012】次に、コンタクト窓を形成する箇所に露出した多結晶膜を、フォトリソグラフィ工程を用いずに、シリコンの酸化膜に対して選択性の高いエッチャントで全面エッチングして除去する。さらに、フッ化水素酸等のフッ素系のエッチャントで、コンタクト窓を形成する箇所の酸化膜が除去されるまで全面エッチングする。この時、コンタクト窓となる箇所の周囲の酸化膜（酸化膜及びCVD酸化膜）も等方的にエッチングされるので、コンタクト窓となる箇所の側面は緩やかに傾斜した形状となり電極の被覆性が向上する。また、コンタクト窓を形成するためのフォトリソグラフィ工程が1回ですむという利点がある。

【0013】請求項3記載のコンタクト窓の形成方法は、表面にMOS構造のゲートを形成する半導体装置にコンタクト窓を形成する方法である。まず、半導体装置の表面に単結晶シリコンの酸化膜を形成し、その酸化膜上に、一部がMOS構造のゲートとなる、ドーパントを含んだシリコンの多結晶膜を形成し、ゲートを形成する箇所及びコンタクト窓を形成する箇所に多結晶膜が残るように、フォトリソグラフィ工程を用いてそれらの箇所以外の多結晶膜を選択的にエッチング除去する。

【0014】次に、熱酸化により多結晶膜を酸化し、絶縁用の酸化膜（CVD酸化膜）を表面に形成し、コンタクト窓を形成する箇所の、熱酸化により形成された酸化膜及びCVD酸化膜をフォトリソグラフィ工程を用いて選択的にエッチング除去した後、コンタクト窓を形成する箇所に露出した多結晶膜を、フォトリソグラフィ工程を用いずに、シリコンの酸化膜に対して選択性の高いエッチャントで全面エッチングして除去する。最後に、フッ化水素酸等のフッ素系のエッチャントで、コンタクト窓を形成する箇所の酸化膜が除去されるまで全面エッチングする。この方法により、請求項2記載の形成方法と

同様に、コンタクト窓となる箇所の側面は緩やかに傾斜した形状となり電極の被覆性が向上する。また、MOS構造のゲートを形成するためのフォトリソグラフィ工程等を、コンタクト窓形成に用いることができるので、著しく工程が増加することがなく、コンタクト窓を形成するためのフォトリソグラフィ工程は1回ですむという利点がある。

【0015】

【実施例】図1の断面図に基づいて本発明のコンタクト窓の形成方法の一実施例について説明する。但し、半導体装置は半導体基板であるとして説明するが、実施例に限定されるものではない。まず、(a)に示すように、半導体基板10の表面にシリコンの酸化膜11を形成し、(b)に示すように、その酸化膜11上に、ドーパントを含まないシリコンの多結晶膜（以下、ノンドープポリシリコン12）を形成する。

【0016】次に、(c)に示すように、このノンドープポリシリコン12上に、CVDにより、高融点膜であるシリコンの窒化膜13を形成し、(d)に示すように、コンタクト窓を形成する箇所の窒化膜13を、フォトリソグラフィ工程を用いて選択的にエッチング除去し開口14を形成する。

【0017】さらに、(e)に示すように、熱酸化により窒化膜13に覆われていないノンドープポリシリコン12（開口14に露出したノンドープポリシリコン12）を完全に酸化して、下層の酸化膜11に達する酸化膜15を形成する。この時、窒化膜13に覆われているノンドープポリシリコン12のうち、開口14近傍の部分は、開口14に近い部分から酸化されることになる。

【0018】次に、(f)に示すように、窒化膜13をマスクにして、フッ化水素酸等のフッ素系のエッチャントで、酸化膜15及びその下層の酸化膜11（コンタクト窓を形成する箇所の酸化膜）を除去してコンタクト窓16を形成した後、残った窒化膜13をエッチング除去するために熱リン酸に浸す。最後に、電極材料を蒸着させ、(g)に示すように、半導体基板10に接触する電極17を形成する。図1に示した実施例では、高融点材料で構成された高融点層は、シリコンの窒化膜であるとして説明したが、高融点層としてタングステン層を用い、同様の方法でコンタクト窓を形成するようにしてもよい。

【0019】図2の断面図に基づいて本発明のコンタクト窓の形成方法の異なる実施例について説明する。図2は、表面にMOS型半導体素子のゲートを形成する半導体基板の表面にコンタクト窓を形成する方法を示したものである。(a)に示すように、MOS型半導体素子の活性領域（図示省略）を形成した半導体基板18の表面にシリコンの酸化膜19を形成し、(b)に示すように、その酸化膜19上に、MOS型半導体素子のゲートとしてのドーパントを含むシリコンの多結晶膜（以下、

ドーパドポリシリコン20）を形成する。

【0020】次に、(c)に示すように、ゲートを形成する箇所、コンタクト窓を形成する箇所に、それぞれ、ドーパドポリシリコン21、22が残るように、ドーパドポリシリコン20をフォトリソグラフィ工程により選択的にエッチング除去する。さらに、(d)に示すように、熱酸化によりドーパドポリシリコン21、22を酸化する。この時、半導体基板18の表面全面に酸化膜23が形成される。

【0021】次に、(e)に示すように、CVDを用いて酸化膜23上に、絶縁用のCVD酸化膜24を形成する。さらに、ドーパドポリシリコン22の領域及びそのドーパドポリシリコン22の側方の周辺領域（ドーパドポリシリコン22から0.5 μm 程度の範囲に入る領域）を開口するパターンを用いてフォトリソグラフィ工程を行い、(f)に示すように、ドーパドポリシリコン22の上方及びその側方の周辺領域の上方に形成されている、酸化膜23及びCVD酸化膜24をエッチング除去する。

【0022】さらに、薄いフッ酸と硝酸の混合液を用いて、(g)に示すように、コンタクト窓を形成する箇所に露出したドーパドポリシリコン22をエッチング除去した後、薄いフッ酸を用いて、コンタクト窓を形成する箇所の酸化膜19、及び、コンタクト窓を形成する箇所の周囲の酸化膜23及びCVD酸化膜24をエッチング除去してコンタクト窓25を形成する。最終的に、

(h)に示すように、コンタクト窓25の箇所で半導体基板10に接触する電極26を形成する。このように構成することにより電極26の被覆性が向上する。

【0023】図2では、ドーパドポリシリコンを用いて、MOS型半導体素子のゲートをコンタクト窓を形成する工程で同時に形成する実施例を示したが、ポリシリコンを用いてゲート以外の構成をコンタクト窓を形成する工程で形成するように構成してもよい。また、図2に示した方法と同様の方法を用いて、独立した工程でコンタクト窓のみを形成するようにしてもよい。図3の断面図に基づいてその工程を説明する。但し、図2に示した構成と同等構成については同符号を付すこととする。

【0024】図3で、(a)に示すように、半導体基板18上に酸化膜19を形成し、(b)に示すように、その酸化膜19上にシリコンの多結晶膜27を形成する。次に、(c)に示すように、コンタクト窓を形成する箇所にポリシリコン28が残るように、ポリシリコン27をフォトリソグラフィ工程により選択的にエッチング除去する。さらに、(d)に示すように、熱酸化によりポリシリコン27を酸化する。この時、半導体基板18の表面全面に酸化膜23が形成される。

【0025】次に、(e)に示すように、CVDを用いて酸化膜23上に、絶縁用のCVD酸化膜24を形成する。さらに、ポリシリコン28の上方及びそのポリシリ

コン28の側方の周辺領域(ポリシリコン28から0.5 μ m程度の範囲に入る領域)を開口するパターンを用いてフォトリソグラフィ工程を行い、(f)に示すように、ポリシリコン28の上方及びその周辺領域の上方に形成されている酸化膜23及びCVD酸化膜24をエッチング除去する。

【0026】さらに、薄いフッ酸と硝酸の混合液を用いて、(g)に示すように、コンタクト窓を形成する箇所に露出したポリシリコン28をエッチング除去した後、薄いフッ酸を用いて、コンタクト窓を形成する箇所の酸化膜19、及び、その周囲の、酸化膜23及びCVD酸化膜24をエッチングしてコンタクト窓25を形成する。最終的に、(h)に示すように、コンタクト窓25の箇所で半導体基板10に接触する電極26を形成する。

【0027】

【発明の効果】以上に説明したように、請求項1乃至請求項3記載のコンタクト窓の形成方法によれば、コンタクト窓のエッジ部分の形状を滑らかな形状にすることができるので電極の被覆性が向上する。これにより、長期にわたって電極の断線を防止することができ電極配線の信頼性向上が図れる。

【0028】請求項3記載のコンタクト窓の形成方法によれば、MOS型半導体素子のゲートを形成するための、フォトリソグラフィ工程等を、コンタクト窓形成に用いることができるので、工程数の著しい増加を招かず電極の被覆性向上が図れる。

【図面の簡単な説明】

【図1】本発明のコンタクト窓の形成方法の一実施例を示す断面図である。

【図2】本発明のコンタクト窓の形成方法の異なる実施例を示す断面図である。

【図3】本発明のコンタクト窓の形成方法のさらに異なる実施例を示す断面図である。

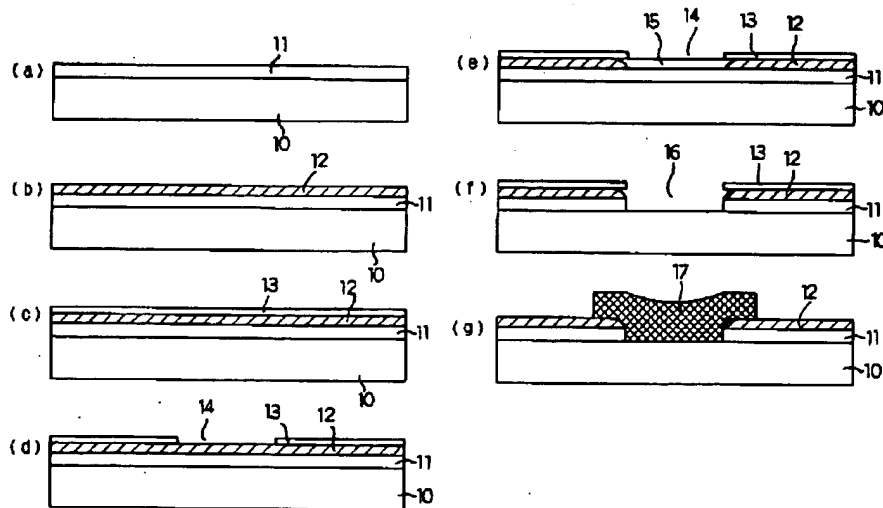
【図4】従来のコンタクト窓の形成方法の一例を示す断面図である。

【図5】従来のコンタクト窓の形成方法の異なる例を示す断面図である。

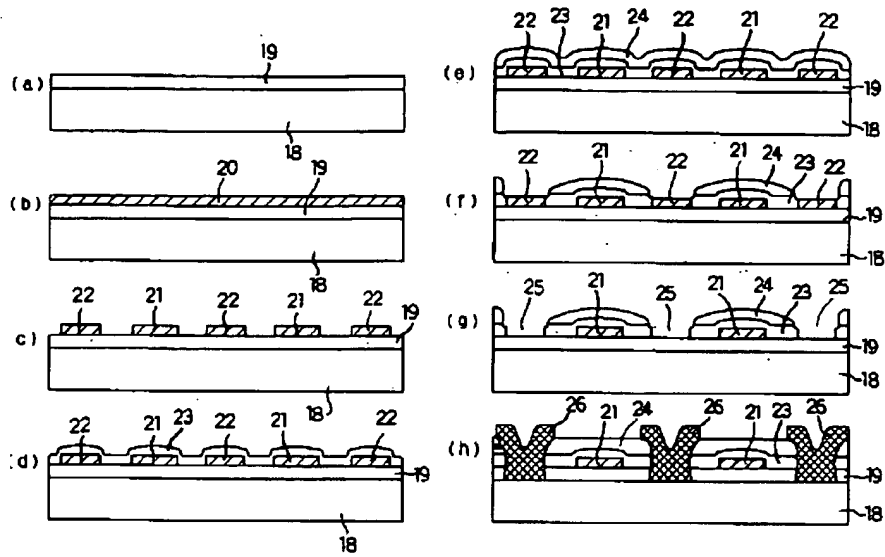
【符号の説明】

10, 18	半導体基板(半導体装置)
11, 19, 23	酸化膜
12	ノンドーパドポリシリコン(多結晶膜)
13	高融点膜
16, 25	コンタクト窓
17, 26	電極
20, 21, 22	ドーパドポリシリコン(多結晶膜)
21	ドーパドポリシリコン(ゲート)
24	CVD酸化膜
27, 28	ポリシリコン(多結晶膜)

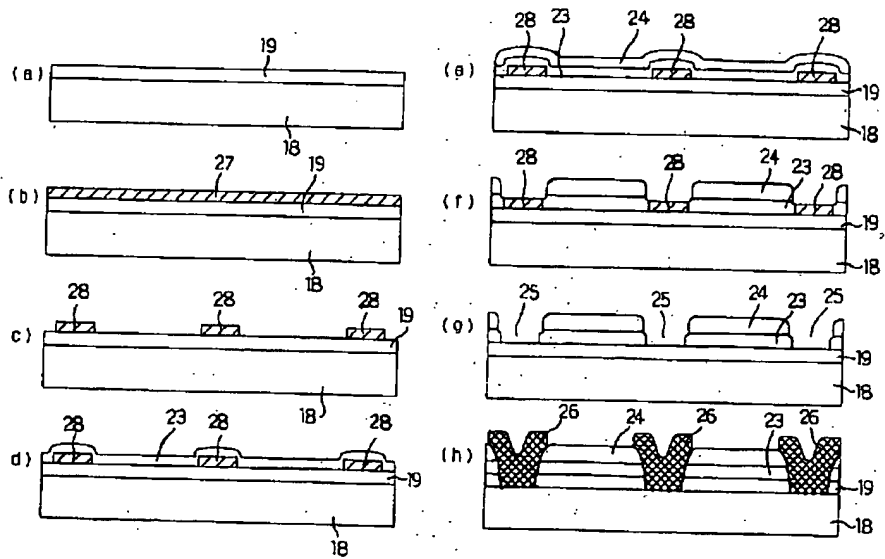
【図1】



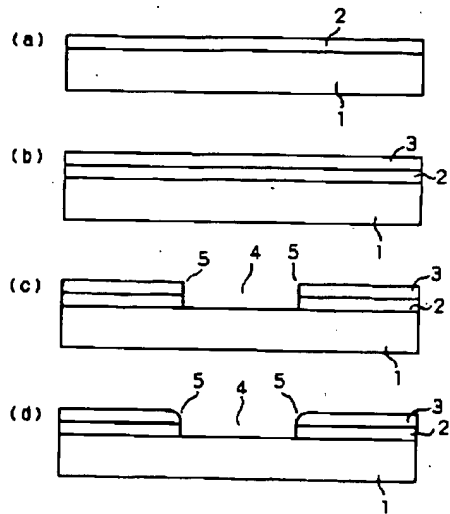
【図2】



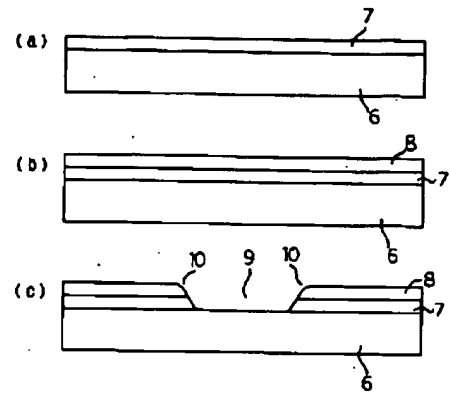
【図3】



【図4】



【図5】



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CLAIMS

[Claim(s)]

[Claim 1] The process which is the approach of forming the contact aperture for contacting an electrode on the surface of a semiconductor device, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film of single crystal silicon which does not contain the dopant which contributes to electric conduction on the oxide film, The process which forms the high-melting film which consisted of refractory materials on the polycrystal film, The process which carries out etching removal of said high-melting film of the part which forms a contact aperture alternatively, The process which oxidizes said polycrystal film of the part which forms said contact aperture by thermal oxidation, The formation approach of the contact aperture characterized by having the process which removes said oxide film of the part which forms said contact aperture by the etchant of a fluorine system, and the process which carries out etching removal of said high-melting film.

[Claim 2] The process which is the approach of forming the contact aperture for contacting an electrode on the surface of a semiconductor device, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film of single crystal silicon on the oxide film, and the process which carries out etching removal of said polycrystal film around the part which forms said contact aperture alternatively, The process which oxidizes said polycrystal film by thermal oxidation, and the process which forms a CVD oxide film in a front face by CVD, The process which carries out etching removal of the oxide film and CVD oxide film which were formed of thermal oxidation of the part which forms said contact aperture alternatively, The process which carries out etching removal of said polycrystal film exposed to the part which forms said contact aperture, The formation approach of the contact aperture characterized by having the process which removes said oxide film of the part which forms said contact aperture, said oxide film of the circumference of it, and said CVD oxide film by the etchant of a fluorine system.

[Claim 3] The process which is the approach of forming the contact aperture for contacting a surface predetermined field and a surface electrode, and forms the oxide film of single crystal silicon in the front face of said semiconductor device with the semiconductor device which forms the gate of metal-oxide-semiconductor structure in a front face, The process which forms the polycrystal film containing the dopant which contributes to electric conduction of single crystal silicon on the oxide film, The process which carries out etching removal of said polycrystal film other than the part which forms the part which forms said gate, and said contact aperture alternatively, The process which forms a CVD oxide film in a front face by CVD, and the process which carries out etching removal of said oxide film and CVD oxide film of the part which forms said contact aperture, The process which carries out etching removal of said polycrystal film exposed to the part which forms said contact aperture, The formation approach of the contact aperture characterized by having the process which removes said oxide film of the part which forms said contact aperture, said oxide film of the circumference of it, and said CVD oxide film by the etchant of a fluorine system.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Industrial Application] This invention and one micrometer It is related with the formation approach of contact apertures, such as an MOS semiconductor device of the Ruhr level.

[0002]

[Description of the Prior Art] 1 micrometer A detailed process does not specialize but various processes are devised by formation of the contact aperture of the semiconductor device of the Ruhr level. Here, two examples are explained among those.

[0003] Based on the sectional view of drawing 4, an example of the formation approach of the conventional contact aperture is explained. Generally, before forming a contact aperture, it is in the condition that the oxide film 2 for an insulation was formed in the front face of the semi-conductor substrate 1, as [show / in (a)]. As it is, If the contact aperture of a detailed pattern is opened, since the covering nature of the electrode formed in the contact aperture worsens, as the level difference section will be in a stairway condition, and it is shown in (b), the CVD oxide film 3 with a little bad compactness will be vapor-deposited on an oxide film 2 from an oxide film 2. Next, as shown in (c), etching removal of the oxide film 2 and the CVD oxide film 3 of a part to form a contact aperture in is carried out alternatively, and the contact aperture 4 is formed. Furthermore, as shown in (d), by annealing (heat treatment), the edge 5 of the upper limit section of the CVD oxide film 3 of contact aperture 4 perimeter is rounded off, and the covering nature of the electrode formed in the contact aperture 4 is improved.

[0004] The example from which the formation approach of the conventional contact aperture differs based on the sectional view of drawing 5 is explained. First, as shown in (a), after forming the oxide film 7 for an insulation in the front face of the semi-conductor base 6, as shown in (b), the CVD oxide film (hereafter referred to as PSG8.) containing P2O5 is vapor-deposited on an oxide film 7. Next, if the oxide film 7 and PSG8 of a part to form a contact aperture in are alternatively etched as shown in (c), since the etching speed of PSG8 is quicker than an oxide film 7, and the edge 10 of the contact aperture 9 becomes a smooth configuration, the covering nature of an electrode will be improved.

[0005]

[Problem(s) to be Solved by the Invention] However, it was difficult to form a contact aperture in the configuration shown in drawing 4 and drawing 5 stably by the approach explained above.

[0006] This invention is 1 micrometer the place which it was made in view of the above-mentioned technical problem, and is made into the purpose. It is in offering the formation approach of the contact aperture which can form the good contact aperture of the covering nature of an electrode stably in the semiconductor device of the Ruhr level.

[0007]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the formation approach of a contact aperture according to claim 1 The process which is the approach of forming the contact aperture for contacting an electrode on the surface of a semiconductor device, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film of single crystal silicon which does not contain the dopant which contributes to electric conduction on the oxide film, The process which forms the high-melting film which consisted of refractory materials on the polycrystal film, The process which carries out etching removal of said high-melting film of the part which forms a contact aperture alternatively, It is characterized by having the process which oxidizes said polycrystal film of the part which forms said contact aperture by thermal oxidation, the process which removes said oxide film of the part which forms said contact aperture by the etchant of a fluorine system, and the process which carries out etching removal of said high-melting film.

[0008] The process which the formation approach of a contact aperture according to claim 2 is the approach of forming the contact aperture for contacting an electrode on the surface of a semiconductor device, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film of single crystal silicon on the oxide film, and the process which carries out etching removal of said polycrystal film around the part which forms said contact aperture alternatively, The process which oxidizes said polycrystal film by thermal oxidation, and the process which forms a CVD oxide film in a front face by CVD, The process which carries out etching removal of the oxide film and CVD oxide film which were formed of thermal oxidation of the part which forms said contact aperture alternatively, The process which carries out etching removal of said polycrystal film exposed to the part which forms said contact aperture, It is characterized by having the process which removes said oxide film of the part which forms said contact aperture, said oxide film of the circumference of it, and said CVD oxide film by the etchant of a fluorine system.

[0009] The formation approach of a contact aperture according to claim 3 is the semiconductor device which forms the gate of metal-oxide-semiconductor structure in a front face. The process which is the approach of forming the contact aperture for contacting a surface predetermined field and a surface electrode, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film containing the dopant which contributes to electric conduction of single crystal silicon on the oxide film, The process which carries out etching removal of said polycrystal film other than the part which forms the part which forms said gate, and said contact aperture alternatively, The process which forms a CVD oxide film in a front face by CVD, and the process which carries out etching removal of said oxide film and CVD oxide film of the part which forms said contact aperture, The process which carries out etching removal of said polycrystal film exposed to the part which forms said contact aperture, It is characterized by having the process which removes said oxide film of the part which forms said contact aperture, said oxide film of the circumference of it, and said CVD oxide film by the etchant of a fluorine system.

[0010]

[Function] First, the formation approach of a contact aperture according to claim 1 forms the oxide film of single crystal silicon on the surface of a semiconductor device, forms the polycrystal film of single crystal silicon which does not contain the dopant which contributes to electric conduction on the oxide film, and forms the high-melting film which consisted of possible refractory materials of selectivity etching on the polycrystal film. Next, etching removal of the high-melting film of the part which should form a contact aperture is carried out alternatively, the polycrystal film (polycrystal film of the part which forms a contact aperture) which is not covered with the high-melting film by thermal oxidation is oxidized completely, the polycrystal film is locally changed into the oxide film, and overall etching is carried out by the etchant of fluorine systems, such as a hydrofluoric acid. Thereby, the oxide film of the part which should form a contact aperture is etched alternatively. Since the polycrystal film near the part which serves as a contact aperture among the polycrystal film covered with the high-melting film in the case of thermal oxidation oxidizes and changes to an oxide film, the upper limit section of a contact aperture serves as a smooth configuration. Thereby, the covering nature of an electrode improves.

[0011] After the formation approach of a contact aperture according to claim 2 removes the polycrystal film of the perimeter by selectivity etching so that the polycrystal film may remain in the part which forms the oxide film of single crystal silicon on the surface of a semiconductor device, forms the polycrystal film of single crystal silicon on the oxide film first, and forms a contact aperture, it oxidizes the polycrystal film by thermal oxidation, and forms the oxide film for an insulation (CVD oxide film) in a front face. Furthermore, etching removal of the oxide film and CVD oxide film which were formed of thermal oxidation of the part which forms a contact aperture is alternatively carried out using a photolithography process.

[0012] Next, without using a photolithography process, to the oxide film of silicon, by the high etchant of selectivity, overall etching of the polycrystal film exposed to the part which forms a contact aperture is carried out, and it is removed. Furthermore, overall etching is carried out until the oxide film of the part which forms a contact aperture is removed by the etchant of fluorine systems, such as a hydrofluoric acid. Since the oxide film around the part used as a contact aperture (an oxide film and CVD oxide film) is also etched isotropic at this time, the side face of the part used as a contact aperture serves as a configuration which inclined gently, and its covering nature of an electrode improves. Moreover, there is an advantage that the photolithography process for forming a contact aperture ends at once.

[0013] The formation approach of a contact aperture according to claim 3 is the approach of forming a contact aperture in the semiconductor device which forms the gate of metal-oxide-semiconductor structure in a front face. First, etching removal of the polycrystal film other than those parts is alternatively carried out using a photolithography process so that the polycrystal film may remain in the part which forms the oxide film of single crystal silicon on the surface of a semiconductor device, and forms the part and contact aperture which form the polycrystal film of the silicon containing

a dopant with which a part serves as the gate of metal-oxide-semiconductor structure, and form the gate on the oxide film.

[0014] Next, after carrying out etching removal of the oxide film and the CVD oxide film formed of thermal oxidation of the part which oxidizes the polycrystal film by thermal oxidation, forms the oxide film for an insulation (CVD oxide film) in a front face, and forms a contact aperture alternatively using a photolithography process, overall etching of the polycrystal film exposed to the part which forms a contact aperture is carried out, and it removes by the high etchant of selectivity to the oxide film of silicon, without using a photolithography process. Overall etching is carried out until the oxide film of the part which forms a contact aperture is finally removed by the etchant of fluorine systems, such as a hydrofluoric acid. By this approach, like the formation approach according to claim 2, the side face of the part used as a contact aperture serves as a configuration which inclined gently, and its covering nature of an electrode improves. Moreover, the photolithography process for a process not increasing remarkably, since the photolithography process for forming the gate of metal-oxide-semiconductor structure etc. can be used for contact fenestration, and forming a contact aperture has the advantage of ending at once.

[0015]

[Example] Based on the sectional view of drawing 1, one example of the formation approach of the contact aperture of this invention is explained. However, although it is explained that a semiconductor device is a semi-conductor substrate, it is not limited to an example. First, as shown in (a), the oxide film 11 of silicon is formed in the front face of the semi-conductor substrate 10, and as shown in (b), the polycrystal film (contest 12 following and non dope polysilicon) of the silicon which does not contain a dopant is formed on the oxide film 11.

[0016] Next, as shown in (c), on contest 12 this non dope polysilicon, by CVD, the nitride 13 of the silicon which is the high-melting film is formed, as shown in (d), etching removal of the nitride 13 of the part which forms a contact aperture is alternatively carried out using a photolithography process, and opening 14 is formed.

[0017] Furthermore, as shown in (e), contest 12 (contest 12 non dope polysilicon exposed to opening 14) non dope polysilicon which is not covered with a nitride 13 by thermal oxidation is oxidized completely, and the oxide film 15 which reaches the lower layer oxide film 11 is formed. At this time, an about 14-opening part will oxidize from the part near opening 14 among contests 12 non dope polysilicon covered with the nitride 13.

[0018] Next, as shown in (f), after using a nitride 13 as a mask, removing an oxide film 15 and its lower layer oxide film 11 (oxide film of the part which forms a contact aperture) by the etchant of fluorine systems, such as a hydrofluoric acid, and forming the contact aperture 16, in order to carry out etching removal of the nitride 13 which remained, it dips in a heat phosphoric acid. Finally, an electrode material is made to vapor-deposit, and as shown in (g), the electrode 17 in contact with the semi-conductor substrate 10 is formed. Although it was explained that the high-melting layer which consisted of refractory materials was the nitride of silicon, you may make it form a contact aperture by the same approach in the example shown in drawing 1, using a tungsten layer as a high-melting layer.

[0019] The example from which the formation approach of the contact aperture of this invention differs based on the sectional view of drawing 2 is explained. Drawing 2 shows how to form a contact aperture in the front face of the semi-conductor substrate which forms the gate of an MOS mold semiconductor device in a front face. As shown in (a), the oxide film 19 of silicon is formed in the front face of the semi-conductor substrate 18 in which the active region (illustration abbreviation) of an MOS mold semiconductor device was formed, and as shown in (b), the polycrystal film (following, doped polysilicon 20) of the silicon containing the dopant as the gate of an MOS mold semiconductor device is formed on the oxide film 19.

[0020] Next, as shown in (c), etching removal of the doped polysilicon 20 is alternatively carried out according to a photolithography process so that doped polysilicon 21 and 22 may remain in the part which forms the gate, and the part which forms a contact aperture, respectively. Furthermore, as shown in (d), doped polysilicon 21 and 22 is oxidized by thermal oxidation. At this time, an oxide film 23 is formed all over the front face of the semi-conductor substrate 18.

[0021] Next, as shown in (e), the CVD oxide film 24 for an insulation is formed on an oxide film 23 using CVD. Furthermore, a photolithography process is performed using the pattern which carries out opening of the field of doped polysilicon 22, and the boundary region (field which goes into the range of 0.5micrometer extent from doped polysilicon 22) of the side of the doped polysilicon 22, and as shown in (f), etching removal of the oxide film 23 and the CVD oxide film 24 which are formed the upper part of doped polysilicon 22 and above the boundary region of the side is carried out.

[0022] Furthermore, as shown in (g), after carrying out etching removal of the doped polysilicon 22 exposed to the part which forms a contact aperture using the mixed liquor of thin fluoric acid and a nitric acid, etching removal of the oxide film 19 of the part which forms a contact aperture, the oxide film 23 around the part which forms a contact aperture, and the CVD oxide film 24 is carried out using thin fluoric acid, and the contact aperture 25 is formed.

Finally, as shown in (h), the electrode 26 which contacts the semi-conductor substrate 10 in the part of the contact aperture 25 is formed. Thus, the covering nature of an electrode 26 improves by constituting.

[0023] Although the example which forms the gate of an MOS mold semiconductor device in coincidence at the process which forms a contact aperture was shown using doped polysilicon, you may constitute from drawing 2 so that the configuration of those other than the gate may be formed at the process which forms a contact aperture using polish recon. Moreover, you may make it form only a contact aperture at the independent process using the approach shown in drawing 2, and the same approach. The process is explained based on the sectional view of drawing 3. However, suppose that a same sign is attached about the configuration and equivalent configuration which were shown in drawing 2.

[0024] As are shown in (a), and an oxide film 19 is formed on the semi-conductor substrate 18 and it is shown in (b) by drawing 3, the polycrystal film 27 of silicon is formed on the oxide film 19. Next, as shown in (c), etching removal of the polish recon 27 is alternatively carried out according to a photolithography process so that the polish recon 28 may remain in the part which forms a contact aperture. Furthermore, as shown in (d), the polish recon 27 is oxidized by thermal oxidation. At this time, an oxide film 23 is formed all over the front face of the semi-conductor substrate 18.

[0025] Next, as shown in (e), the CVD oxide film 24 for an insulation is formed on an oxide film 23 using CVD. Furthermore, a photolithography process is performed using the pattern which carries out opening of the boundary region (field which goes into the range of 0.5micrometer extent from the polish recon 28) of the upper part of the polish recon 28, and the side of the polish recon 28, and as shown in (f), etching removal of the oxide film 23 and the CVD oxide film 24 which are formed the upper part of the polish recon 28 and above the boundary region is carried out.

[0026] Furthermore, as shown in (g), after carrying out etching removal of the polish recon 28 exposed to the part which forms a contact aperture using the mixed liquor of thin fluoric acid and a nitric acid, the oxide film 19 of the part which forms a contact aperture, the oxide film 23 of the perimeter, and the CVD oxide film 24 are etched using thin fluoric acid, and the contact aperture 25 is formed. Finally, as shown in (h), the electrode 26 which contacts the semi-conductor substrate 10 in the part of the contact aperture 25 is formed.

[0027]

[Effect of the Invention] As explained above, since the configuration of the edge part of a contact aperture can be made into a smooth configuration, according to the formation approach of a contact aperture according to claim 1 to 3, the covering nature of an electrode improves. Thereby, an open circuit of an electrode can be prevented over a long period of time, and improvement in dependability of electrode wiring can be aimed at.

[0028] Since the photolithography process for forming the gate of an MOS mold semiconductor device etc. can be used for contact fenestration according to the formation approach of a contact aperture according to claim 3, the covering disposition top of an electrode can be planned without causing the remarkable increment in a routing counter.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention and one micrometer It is related with the formation approach of contact apertures, such as an MOS semiconductor device of the Ruhr level.

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PRIOR ART

[Description of the Prior Art] 1 micrometer A detailed process does not specialize but various processes are devised by formation of the contact aperture of the semiconductor device of the Ruhr level. Here, two examples are explained among those.

[0003] Based on the sectional view of drawing 4, an example of the formation approach of the conventional contact aperture is explained. Generally, before forming a contact aperture, it is in the condition that the oxide film 2 for an insulation was formed in the front face of the semi-conductor substrate 1, as [show / in (a)]. As it is, If the contact aperture of a detailed pattern is opened, since the covering nature of the electrode formed in the contact aperture worsens, as the level difference section will be in a stairway condition, and it is shown in (b), the CVD oxide film 3 with a little bad compactness will be vapor-deposited on an oxide film 2 from an oxide film 2. Next, as shown in (c), etching removal of the oxide film 2 and the CVD oxide film 3 of a part to form a contact aperture in is carried out alternatively, and the contact aperture 4 is formed. Furthermore, as shown in (d), by annealing (heat treatment), the edge 5 of the upper limit section of the CVD oxide film 3 of contact aperture 4 perimeter is rounded off, and the covering nature of the electrode formed in the contact aperture 4 is improved.

[0004] The example from which the formation approach of the conventional contact aperture differs based on the sectional view of drawing 5 is explained. First, as shown in (a), after forming the oxide film 7 for an insulation in the front face of the semi-conductor base 6, as shown in (b), the CVD oxide film (hereafter referred to as PSG8.) containing P2O5 is vapor-deposited on an oxide film 7. Next, if the oxide film 7 and PSG8 of a part to form a contact aperture in are alternatively etched as shown in (c), since the etching speed of PSG8 is quicker than an oxide film 7, and the edge 10 of the contact aperture 9 becomes a smooth configuration, the covering nature of an electrode will be improved.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, since the configuration of the edge part of a contact aperture can be made into a smooth configuration, according to the formation approach of a contact aperture according to claim 1 to 3, the covering nature of an electrode improves. Thereby, an open circuit of an electrode can be prevented over a long period of time, and improvement in dependability of electrode wiring can be aimed at.

[0028] Since the photolithography process for forming the gate of an MOS mold semiconductor device etc. can be used for contact fenestration according to the formation approach of a contact aperture according to claim 3, the covering disposition top of an electrode can be planned without causing the remarkable increment in a routing counter.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, it was difficult to form a contact aperture in the configuration shown in drawing 4 and drawing 5 stably by the approach explained above.

[0006] This invention is 1 micrometer the place which it was made in view of the above-mentioned technical problem, and is made into the purpose. It is in offering the formation approach of the contact aperture which can form the good contact aperture of the covering nature of an electrode stably in the semiconductor device of the Ruhr level.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the formation approach of a contact aperture according to claim 1 The process which is the approach of forming the contact aperture for contacting an electrode on the surface of a semiconductor device, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film of single crystal silicon which does not contain the dopant which contributes to electric conduction on the oxide film, The process which forms the high-melting film which consisted of refractory materials on the polycrystal film, The process which carries out etching removal of said high-melting film of the part which forms a contact aperture alternatively, It is characterized by having the process which oxidizes said polycrystal film of the part which forms said contact aperture by thermal oxidation, the process which removes said oxide film of the part which forms said contact aperture by the etchant of a fluorine system, and the process which carries out etching removal of said high-melting film.

[0008] The process which the formation approach of a contact aperture according to claim 2 is the approach of forming the contact aperture for contacting an electrode on the surface of a semiconductor device, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film of single crystal silicon on the oxide film, and the process which carries out etching removal of said polycrystal film around the part which forms said contact aperture alternatively, The process which oxidizes said polycrystal film by thermal oxidation, and the process which forms a CVD oxide film in a front face by CVD, The process which carries out etching removal of the oxide film and CVD oxide film which were formed of thermal oxidation of the part which forms said contact aperture alternatively, The process which carries out etching removal of said polycrystal film exposed to the part which forms said contact aperture, It is characterized by having the process which removes said oxide film of the part which forms said contact aperture, said oxide film of the circumference of it, and said CVD oxide film by the etchant of a fluorine system.

[0009] The formation approach of a contact aperture according to claim 3 is the semiconductor device which forms the gate of metal-oxide-semiconductor structure in a front face. The process which is the approach of forming the contact aperture for contacting a surface predetermined field and a surface electrode, and forms the oxide film of single crystal silicon in the front face of said semiconductor device, The process which forms the polycrystal film containing the dopant which contributes to electric conduction of single crystal silicon on the oxide film, The process which carries out etching removal of said polycrystal film other than the part which forms the part which forms said gate, and said contact aperture alternatively, The process which forms a CVD oxide film in a front face by CVD, and the process which carries out etching removal of said oxide film and CVD oxide film of the part which forms said contact aperture, The process which carries out etching removal of said polycrystal film exposed to the part which forms said contact aperture, It is characterized by having the process which removes said oxide film of the part which forms said contact aperture, said oxide film of the circumference of it, and said CVD oxide film by the etchant of a fluorine system.

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OPERATION

[Function] First, the formation approach of a contact aperture according to claim 1 forms the oxide film of single crystal silicon on the surface of a semiconductor device, forms the polycrystal film of single crystal silicon which does not contain the dopant which contributes to electric conduction on the oxide film, and forms the high-melting film which consisted of possible refractory materials of selectivity etching on the polycrystal film. Next, etching removal of the high-melting film of the part which should form a contact aperture is carried out alternatively, the polycrystal film (polycrystal film of the part which forms a contact aperture) which is not covered with the high-melting film by thermal oxidation is oxidized completely, the polycrystal film is locally changed into the oxide film, and overall etching is carried out by the etchant of fluorine systems, such as a hydrofluoric acid. Thereby, the oxide film of the part which should form a contact aperture is etched alternatively. Since the polycrystal film near the part which serves as a contact aperture among the polycrystal film covered with the high-melting film in the case of thermal oxidation oxidizes and changes to an oxide film, the upper limit section of a contact aperture serves as a smooth configuration. Thereby, the covering nature of an electrode improves.

[0011] After the formation approach of a contact aperture according to claim 2 removes the polycrystal film of the perimeter by selectivity etching so that the polycrystal film may remain in the part which forms the oxide film of single crystal silicon on the surface of a semiconductor device, forms the polycrystal film of single crystal silicon on the oxide film first, and forms a contact aperture, it oxidizes the polycrystal film by thermal oxidation, and forms the oxide film for an insulation (CVD oxide film) in a front face. Furthermore, etching removal of the oxide film and CVD oxide film which were formed of thermal oxidation of the part which forms a contact aperture is alternatively carried out using a photolithography process.

[0012] Next, without using a photolithography process, to the oxide film of silicon, by the high etchant of selectivity, overall etching of the polycrystal film exposed to the part which forms a contact aperture is carried out, and it is removed. Furthermore, overall etching is carried out until the oxide film of the part which forms a contact aperture is removed by the etchant of fluorine systems, such as a hydrofluoric acid. Since the oxide film around the part used as a contact aperture (an oxide film and CVD oxide film) is also etched isotropic at this time, the side face of the part used as a contact aperture serves as a configuration which inclined gently, and its covering nature of an electrode improves. Moreover, there is an advantage that the photolithography process for forming a contact aperture ends at once.

[0013] The formation approach of a contact aperture according to claim 3 is the approach of forming a contact aperture in the semiconductor device which forms the gate of metal-oxide-semiconductor structure in a front face. First, etching removal of the polycrystal film other than those parts is alternatively carried out using a photolithography process so that the polycrystal film may remain in the part which forms the oxide film of single crystal silicon on the surface of a semiconductor device, and forms the part and contact aperture which form the polycrystal film of the silicon containing a dopant with which a part serves as the gate of metal-oxide-semiconductor structure, and form the gate on the oxide film.

[0014] Next, after carrying out etching removal of the oxide film and the CVD oxide film formed of thermal oxidation of the part which oxidizes the polycrystal film by thermal oxidation, forms the oxide film for an insulation (CVD oxide film) in a front face, and forms a contact aperture alternatively using a photolithography process, overall etching of the polycrystal film exposed to the part which forms a contact aperture is carried out, and it removes by the high etchant of selectivity to the oxide film of silicon, without using a photolithography process. Overall etching is carried out until the oxide film of the part which forms a contact aperture is finally removed by the etchant of fluorine systems, such as a hydrofluoric acid. By this approach, like the formation approach according to claim 2, the side face of the part used as a contact aperture serves as a configuration which inclined gently, and its covering nature of an electrode improves. Moreover, the photolithography process for a process not increasing remarkably, since the photolithography process for

forming the gate of metal-oxide-semiconductor structure etc. can be used for contact fenestration, and forming a contact aperture has the advantage of ending at once.

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EXAMPLE

[Example] Based on the sectional view of drawing 1, one example of the formation approach of the contact aperture of this invention is explained. However, although it is explained that a semiconductor device is a semi-conductor substrate, it is not limited to an example. First, as shown in (a), the oxide film 11 of silicon is formed in the front face of the semi-conductor substrate 10, and as shown in (b), the polycrystal film (contest 12 following and non dope polysilicon) of the silicon which does not contain a dopant is formed on the oxide film 11.

[0016] Next, as shown in (c), on contest 12 this non dope polysilicon, by CVD, the nitride 13 of the silicon which is the high-melting film is formed, as shown in (d), etching removal of the nitride 13 of the part which forms a contact aperture is alternatively carried out using a photolithography process, and opening 14 is formed.

[0017] Furthermore, as shown in (e), contest 12 (contest 12 non dope polysilicon exposed to opening 14) non dope polysilicon which is not covered with a nitride 13 by thermal oxidation is oxidized completely, and the oxide film 15 which reaches the lower layer oxide film 11 is formed. At this time, an about 14-opening part will oxidize from the part near opening 14 among contests 12 non dope polysilicon covered with the nitride 13.

[0018] Next, as shown in (f), after using a nitride 13 as a mask, removing an oxide film 15 and its lower layer oxide film 11 (oxide film of the part which forms a contact aperture) by the etchant of fluorine systems, such as a hydrofluoric acid, and forming the contact aperture 16, in order to carry out etching removal of the nitride 13 which remained, it dips in a heat phosphoric acid. Finally, an electrode material is made to vapor-deposit, and as shown in (g), the electrode 17 in contact with the semi-conductor substrate 10 is formed. Although it was explained that the high-melting layer which consisted of refractory materials was the nitride of silicon, you may make it form a contact aperture by the same approach in the example shown in drawing 1, using a tungsten layer as a high-melting layer.

[0019] The example from which the formation approach of the contact aperture of this invention differs based on the sectional view of drawing 2 is explained. Drawing 2 shows how to form a contact aperture in the front face of the semi-conductor substrate which forms the gate of an MOS mold semiconductor device in a front face. As shown in (a), the oxide film 19 of silicon is formed in the front face of the semi-conductor substrate 18 in which the active region (illustration abbreviation) of an MOS mold semiconductor device was formed, and as shown in (b), the polycrystal film (following, doped polysilicon 20) of the silicon containing the dopant as the gate of an MOS mold semiconductor device is formed on the oxide film 19.

[0020] Next, as shown in (c), etching removal of the doped polysilicon 20 is alternatively carried out according to a photolithography process so that doped polysilicon 21 and 22 may remain in the part which forms the gate, and the part which forms a contact aperture, respectively. Furthermore, as shown in (d), doped polysilicon 21 and 22 is oxidized by thermal oxidation. At this time, an oxide film 23 is formed all over the front face of the semi-conductor substrate 18.

[0021] Next, as shown in (e), the CVD oxide film 24 for an insulation is formed on an oxide film 23 using CVD. Furthermore, a photolithography process is performed using the pattern which carries out opening of the field of doped polysilicon 22, and the boundary region (field which goes into the range of 0.5micrometer extent from doped polysilicon 22) of the side of the doped polysilicon 22, and as shown in (f), etching removal of the oxide film 23 and the CVD oxide film 24 which are formed the upper part of doped polysilicon 22 and above the boundary region of the side is carried out.

[0022] Furthermore, as shown in (g), after carrying out etching removal of the doped polysilicon 22 exposed to the part which forms a contact aperture using the mixed liquor of thin fluoric acid and a nitric acid, etching removal of the oxide film 19 of the part which forms a contact aperture, the oxide film 23 around the part which forms a contact aperture, and the CVD oxide film 24 is carried out using thin fluoric acid, and the contact aperture 25 is formed. Finally, as shown in (h), the electrode 26 which contacts the semi-conductor substrate 10 in the part of the contact aperture 25 is formed. Thus, the covering nature of an electrode 26 improves by constituting.

[0023] Although the example which forms the gate of an MOS mold semiconductor device in coincidence at the process which forms a contact aperture was shown using doped polysilicon, you may constitute from drawing 2 so that the configuration of those other than the gate may be formed at the process which forms a contact aperture using polish recon. Moreover, you may make it form only a contact aperture at the independent process using the approach shown in drawing 2, and the same approach. The process is explained based on the sectional view of drawing 3. However, suppose that a same sign is attached about the configuration and equivalent configuration which were shown in drawing 2.

[0024] As are shown in (a), and an oxide film 19 is formed on the semi-conductor substrate 18 and it is shown in (b) by drawing 3, the polycrystal film 27 of silicon is formed on the oxide film 19. Next, as shown in (c), etching removal of the polish recon 27 is alternatively carried out according to a photolithography process so that the polish recon 28 may remain in the part which forms a contact aperture. Furthermore, as shown in (d), the polish recon 27 is oxidized by thermal oxidation. At this time, an oxide film 23 is formed all over the front face of the semi-conductor substrate 18.

[0025] Next, as shown in (e), the CVD oxide film 24 for an insulation is formed on an oxide film 23 using CVD. Furthermore, a photolithography process is performed using the pattern which carries out opening of the boundary region (field which goes into the range of 0.5micrometer extent from the polish recon 28) of the upper part of the polish recon 28, and the side of the polish recon 28, and as shown in (f), etching removal of the oxide film 23 and the CVD oxide film 24 which are formed the upper part of the polish recon 28 and above the boundary region is carried out.

[0026] Furthermore, as shown in (g), after carrying out etching removal of the polish recon 28 exposed to the part which forms a contact aperture using the mixed liquor of thin fluoric acid and a nitric acid, the oxide film 19 of the part which forms a contact aperture, the oxide film 23 of the perimeter, and the CVD oxide film 24 are etched using thin fluoric acid, and the contact aperture 25 is formed. Finally, as shown in (h), the electrode 26 which contacts the semi-conductor substrate 10 in the part of the contact aperture 25 is formed.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing one example of the formation approach of the contact aperture of this invention.

[Drawing 2] It is the sectional view showing the example from which the formation approach of the contact aperture of this invention differs.

[Drawing 3] It is the sectional view showing the example from which the formation approach of the contact aperture of this invention differs further.

[Drawing 4] It is the sectional view showing an example of the formation approach of the conventional contact aperture.

[Drawing 5] It is the sectional view showing the example from which the formation approach of the conventional contact aperture differs.

[Description of Notations]

10 18 Semi-conductor substrate (semiconductor device)

11, 19, 23 Oxide film

12 [] Non Doped Polysilicon (Polycrystal Film)

13 [] High-melting Film

16 25 Contact aperture

17 26 Electrode

20, 21, 22 Doped polysilicon (polycrystal film)

21 [] Doped Polysilicon (Gate)

24 [] CVD Oxide Film

27 28 Polish recon (polycrystal film)

[Translation done.]

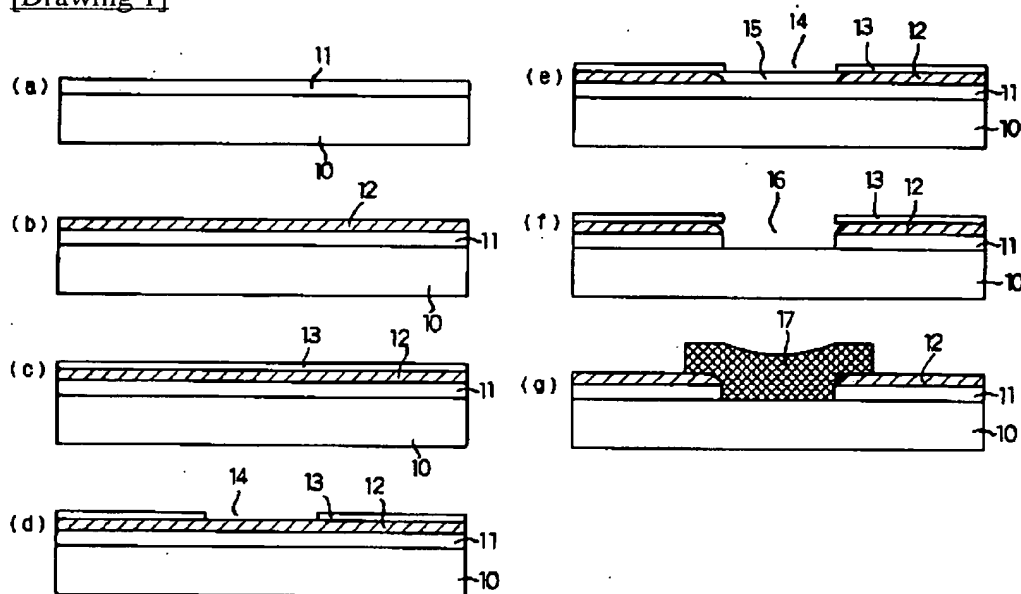
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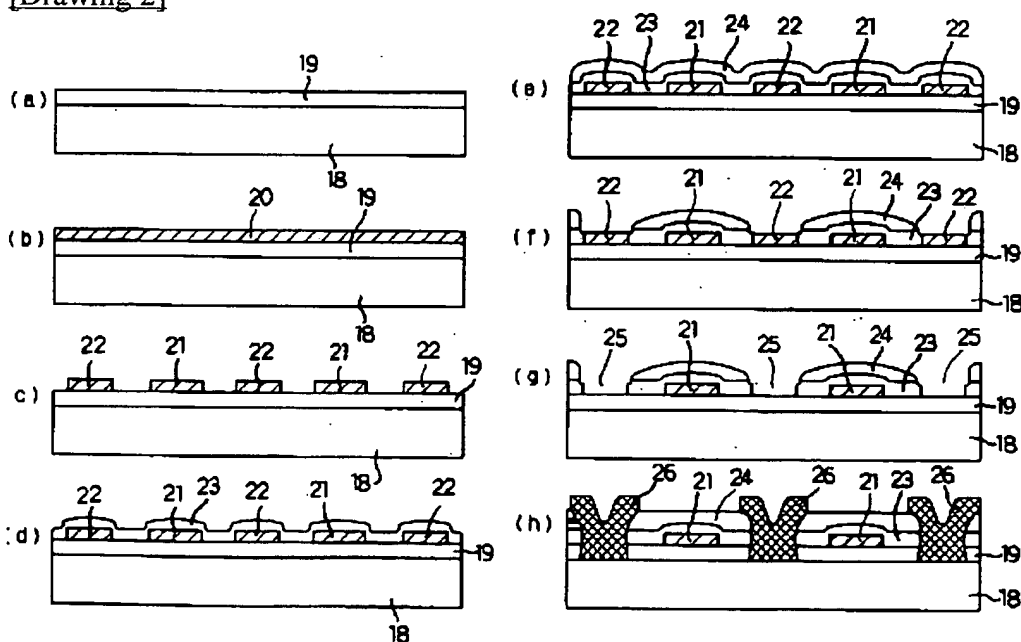
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DRAWINGS

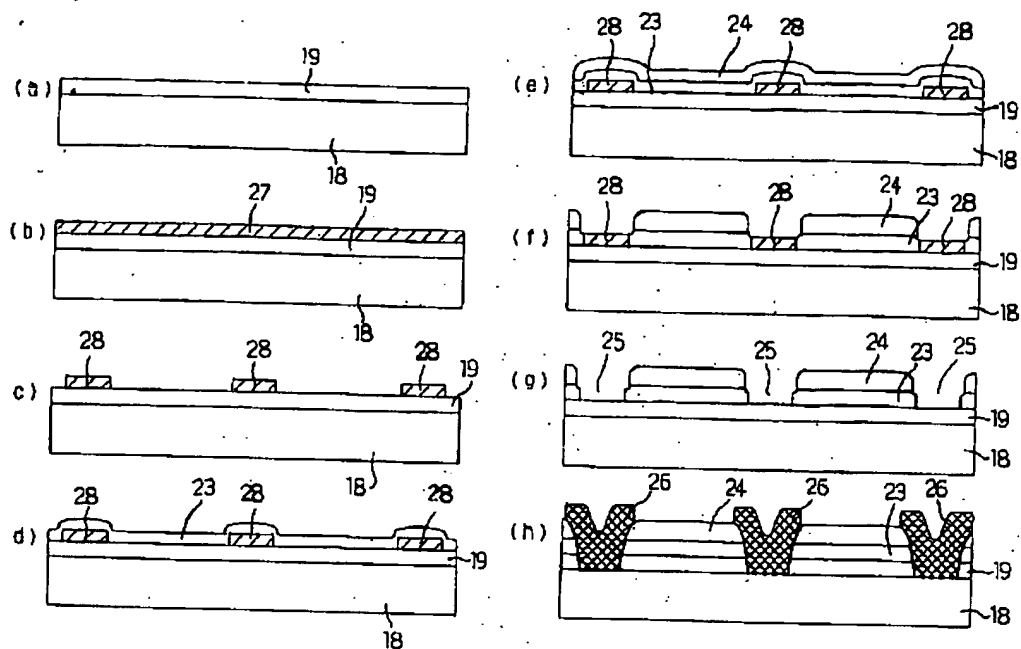
[Drawing 1]



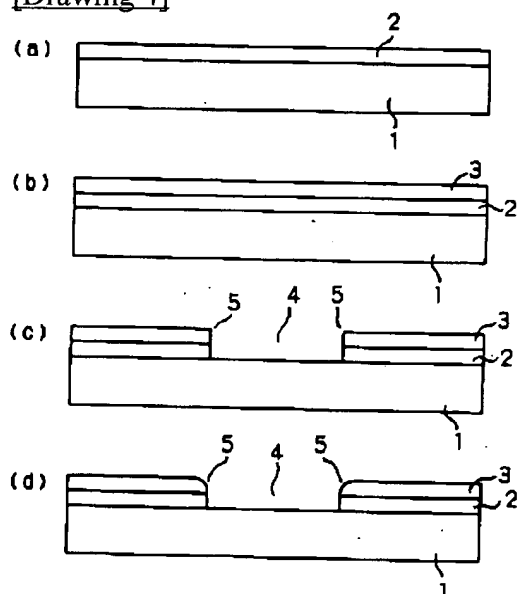
[Drawing 2]



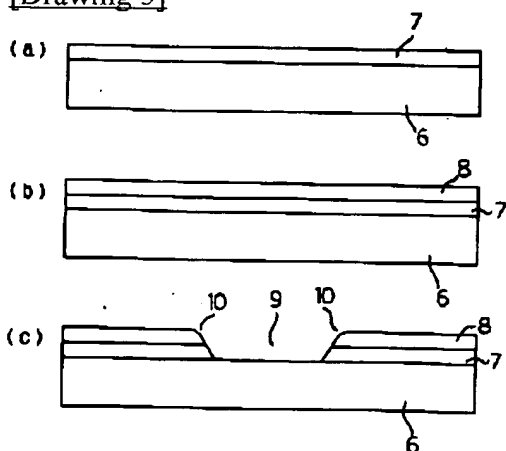
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]